MERGER-INDUCED QUASARS, THEIR LIGHT CURVES AND THEIR HOSTs

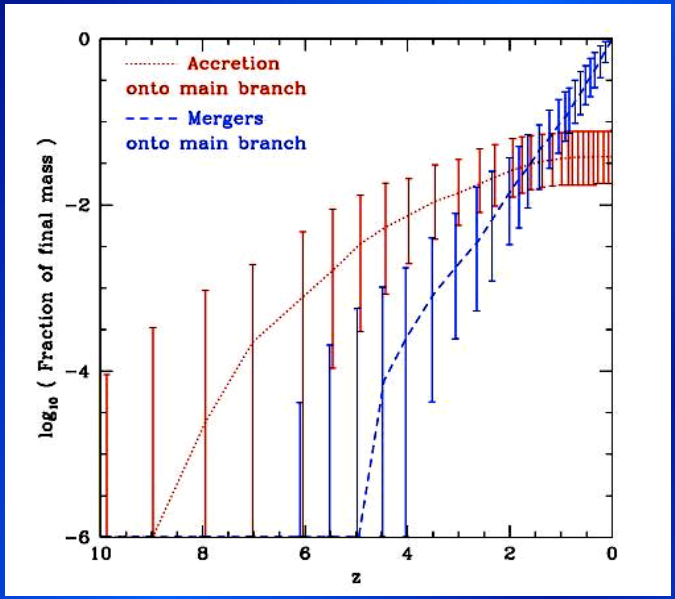
Francesco Shankar

with: D. Weinberg, M. Bernardi, F. Marulli, J. Moreno, Y. Shen, R. Sheth, J. Miralda-Escude', L. Ferrarese, C. Li, M. Crocce, R. Angulo

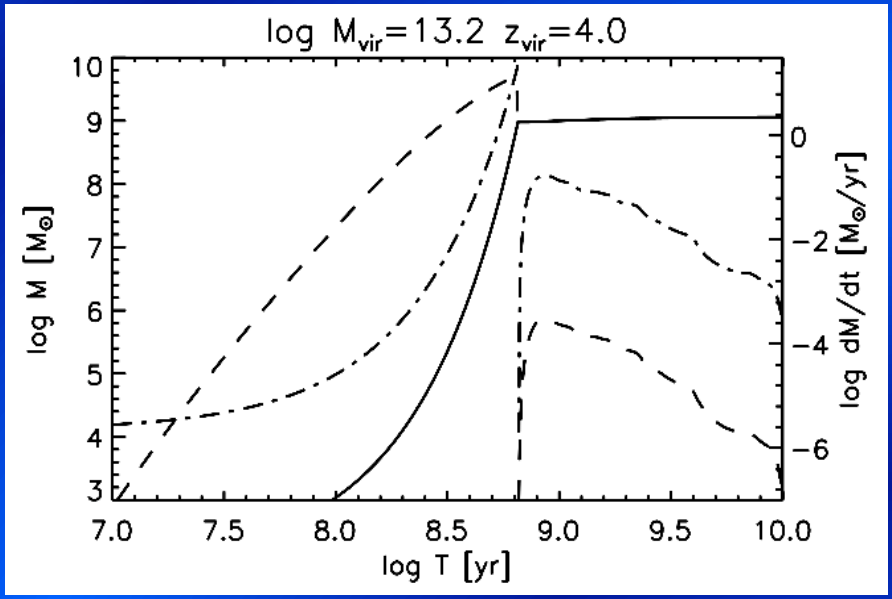
Durham, "What drives the Growth of Black Holes?"
28/07/10

Max-Planck-Institut für Astrophysik

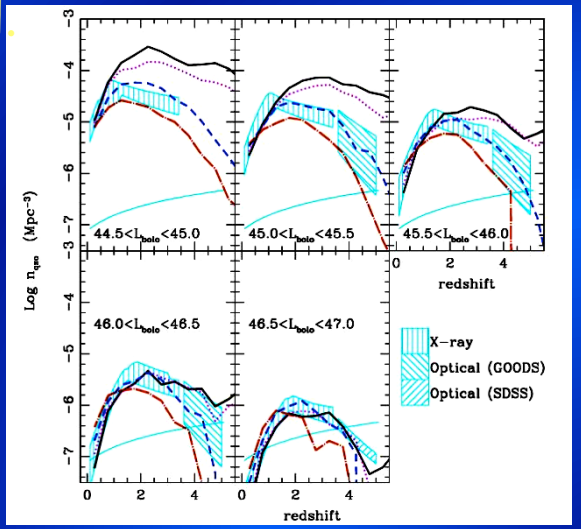
SAMs are working hard to understand what is going on...



Malbon et al.



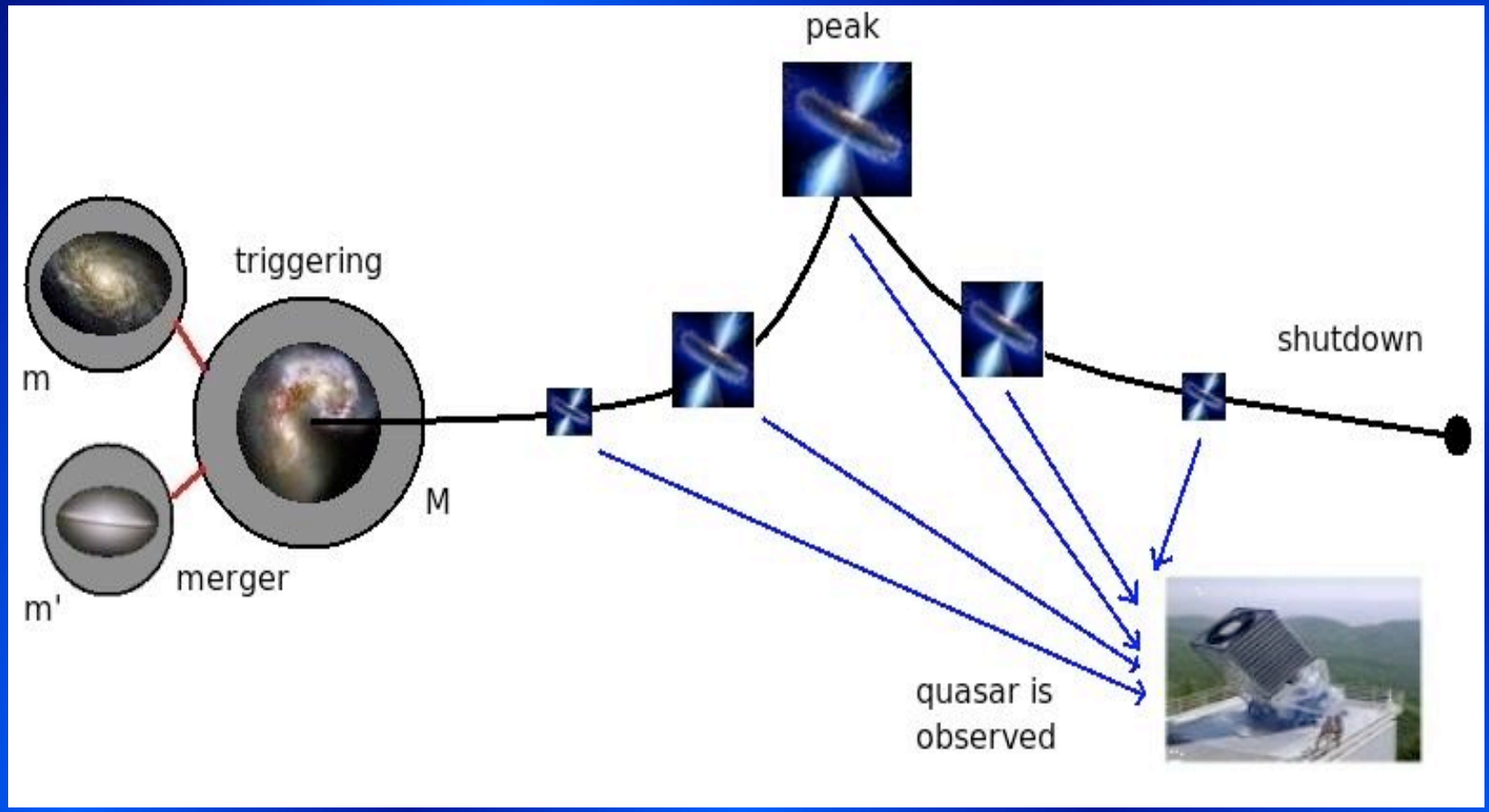
Lapi, FS, et al.



Fontanot et al.

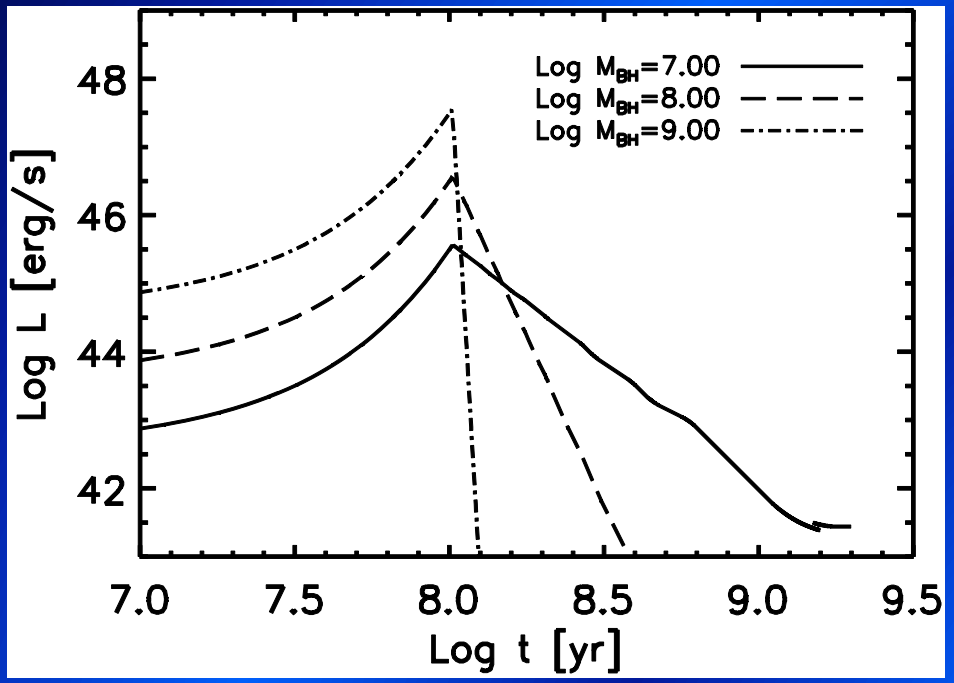
``our knowledge on the physics of accretion onto BHs and their interaction with galaxies is still poor to draw firm conclusions''

A basic model for QSOs



$$\Phi(L,z) = \iint dM_H dt \frac{d^2 n_H}{dM_H dt} P[L \mid M_H, t, z]$$

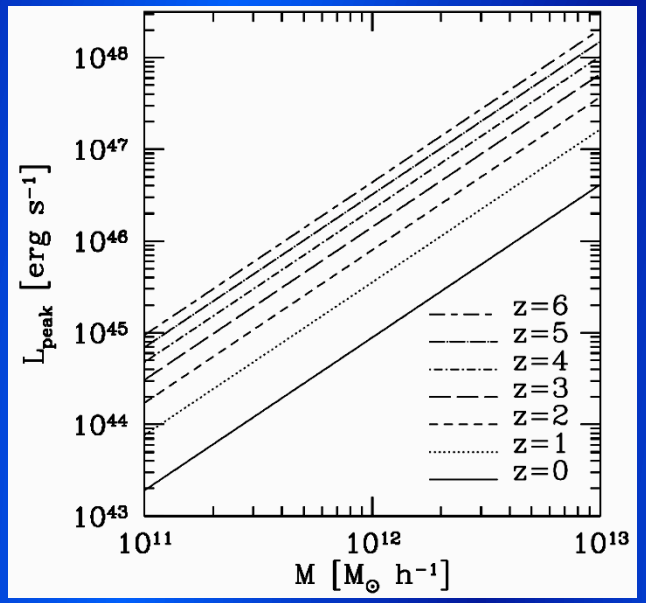
Second Ingredient: BH Light Curve

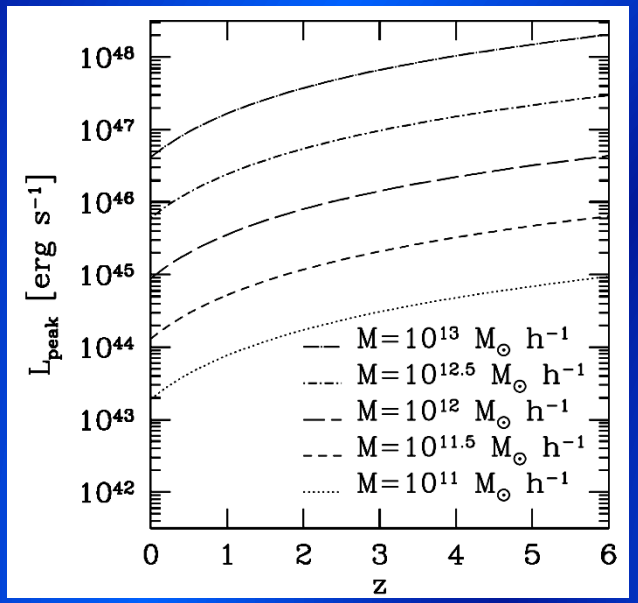


Mass-dependent Light Curve: more Extended for less Massive BHs

Feedback-Constrained L_{peak}:

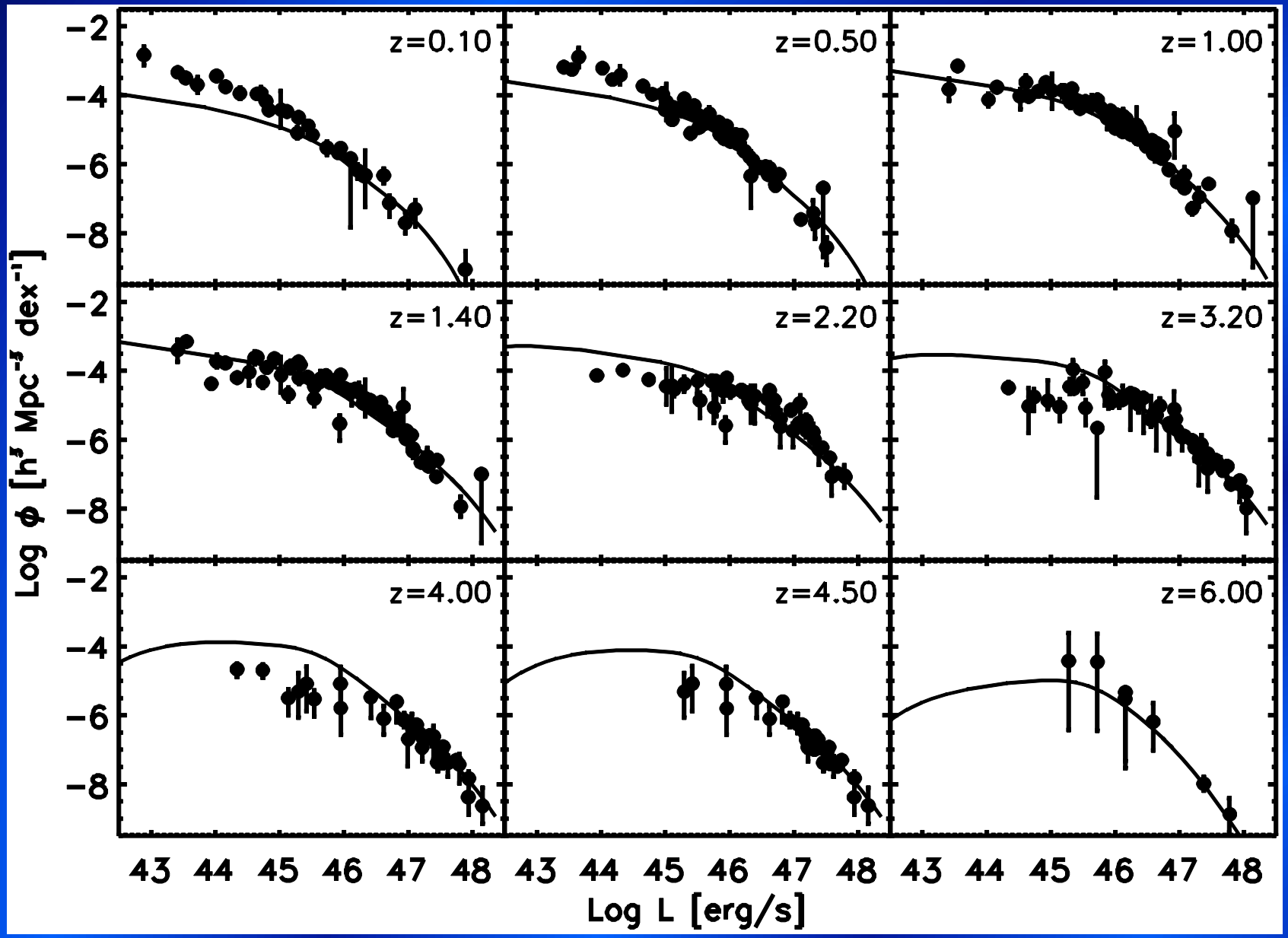
$$L_{PEAK} \sim M_H^{\frac{4}{3} \div \frac{5}{3}} (1+z)^{1.5}$$





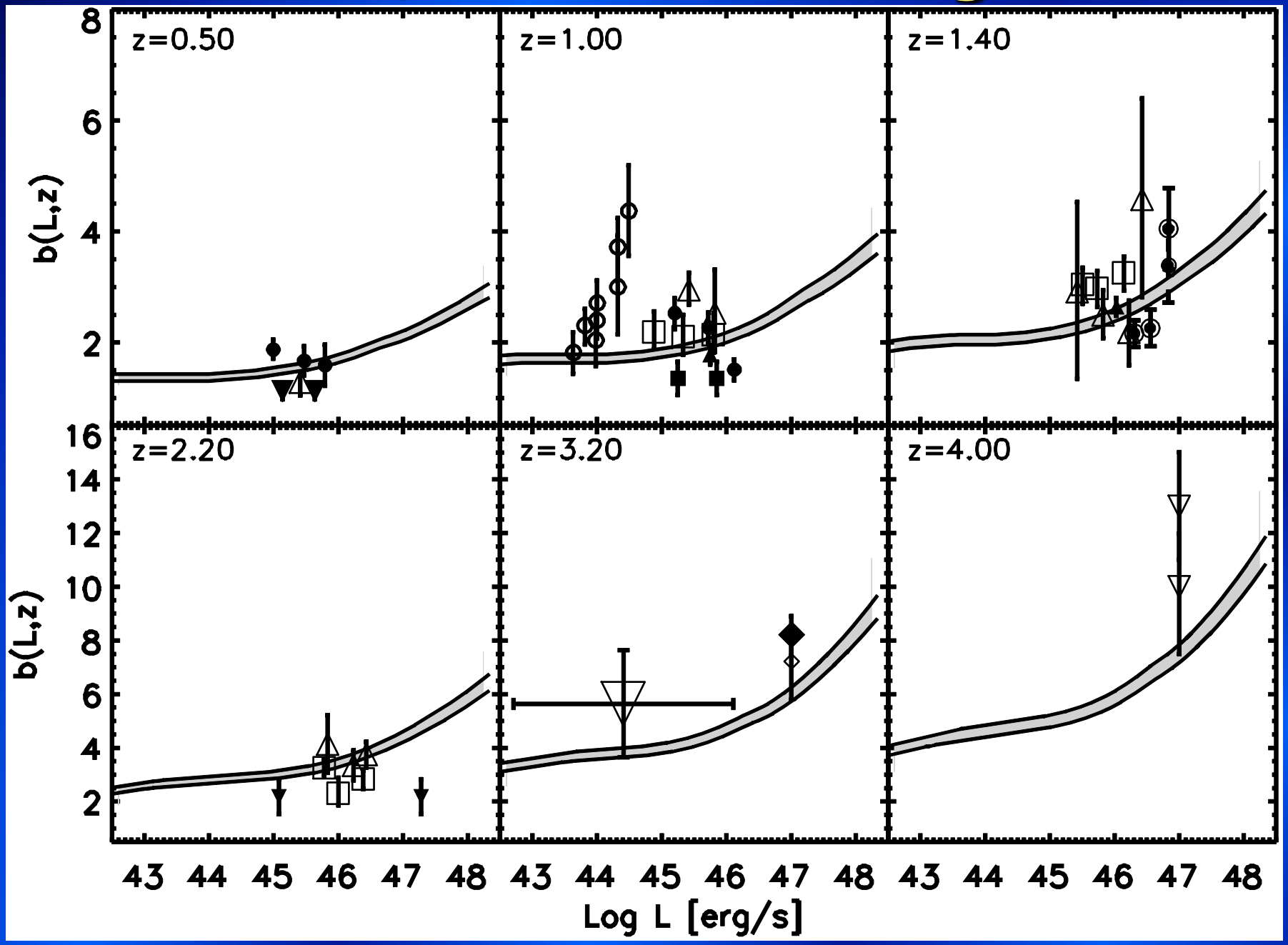
See Power's talk

The luminosity function

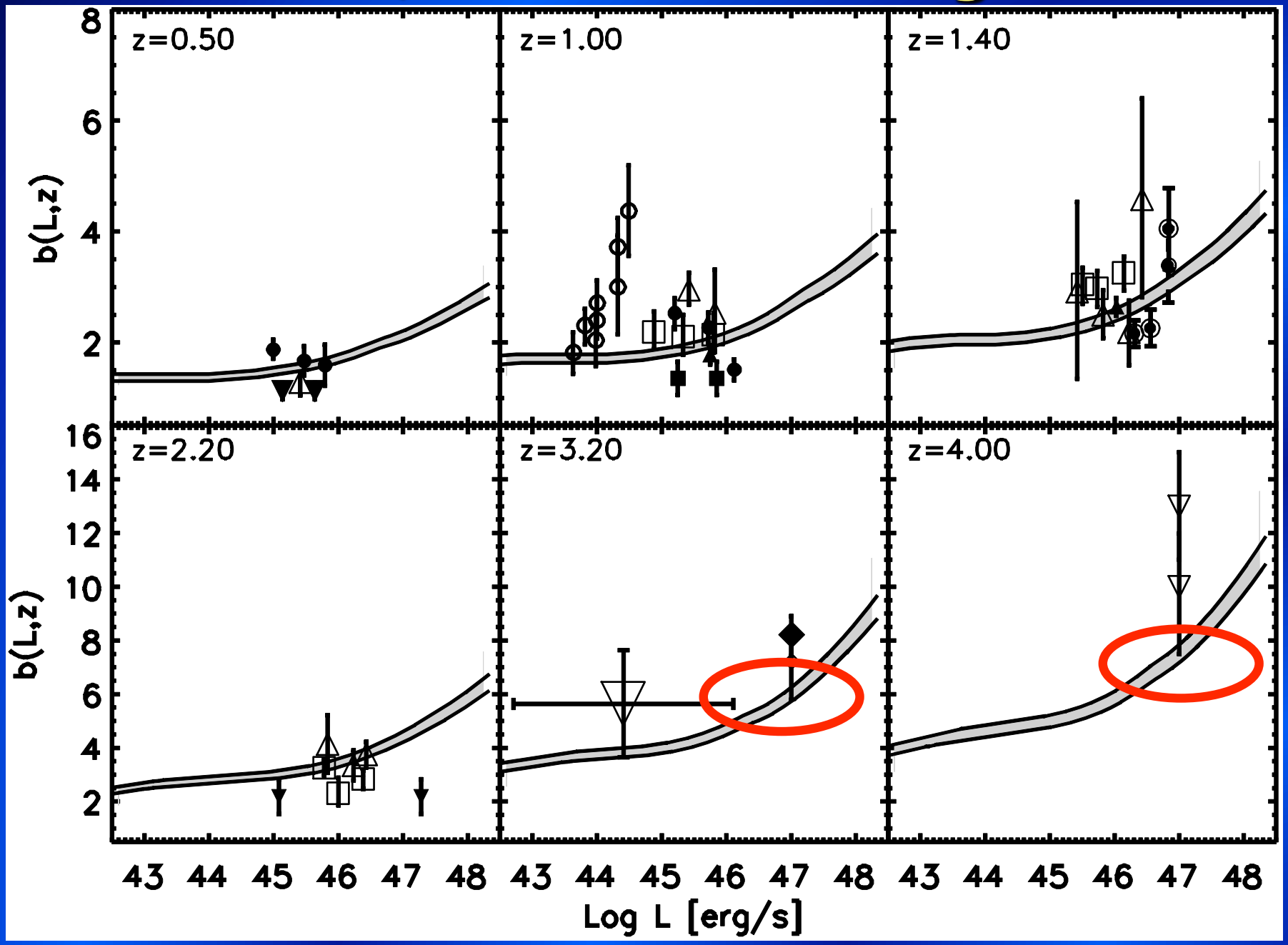


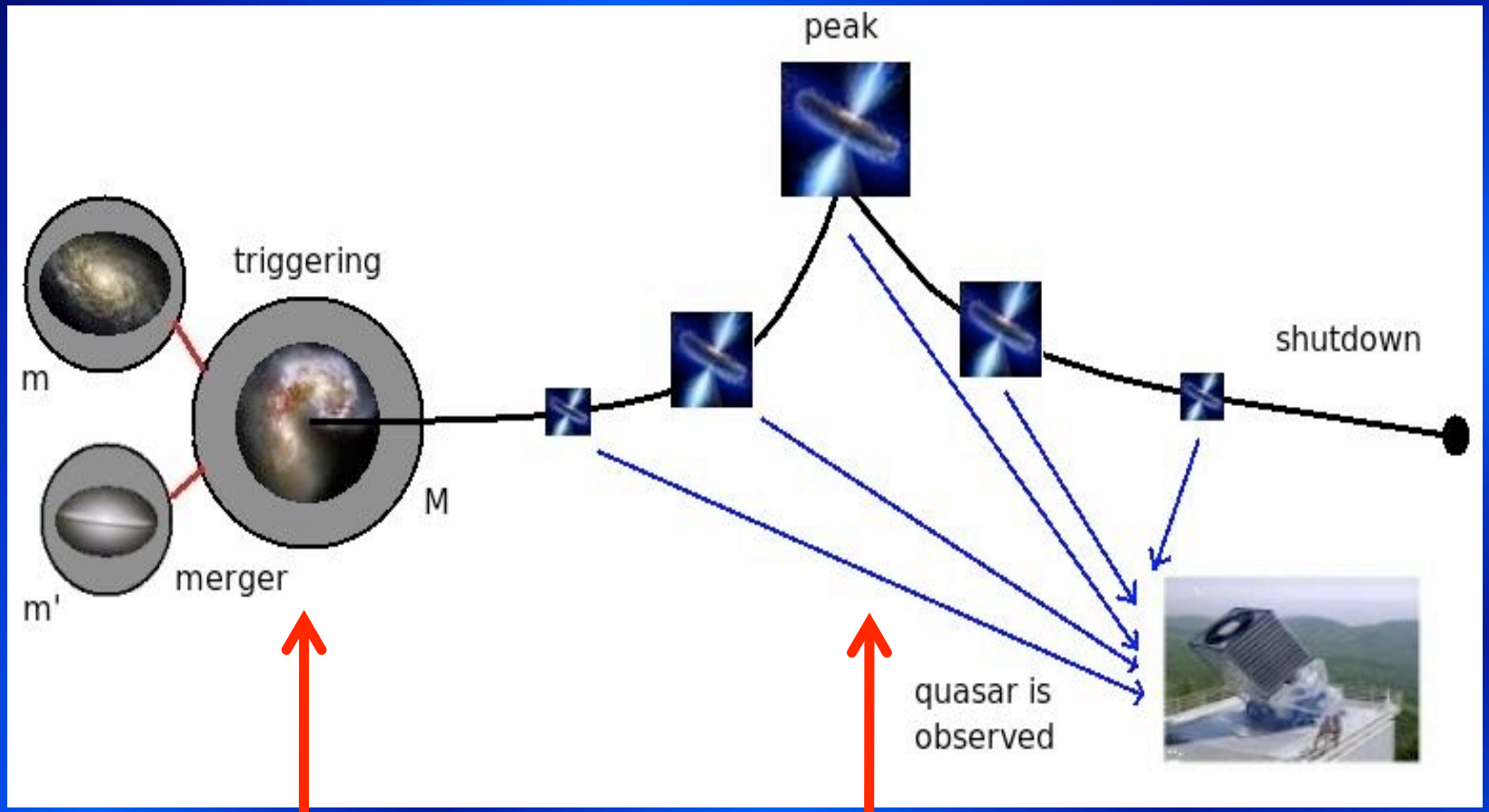
See talk by Lutz and poster by M. Cisternas

Quasar clustering



Quasar clustering

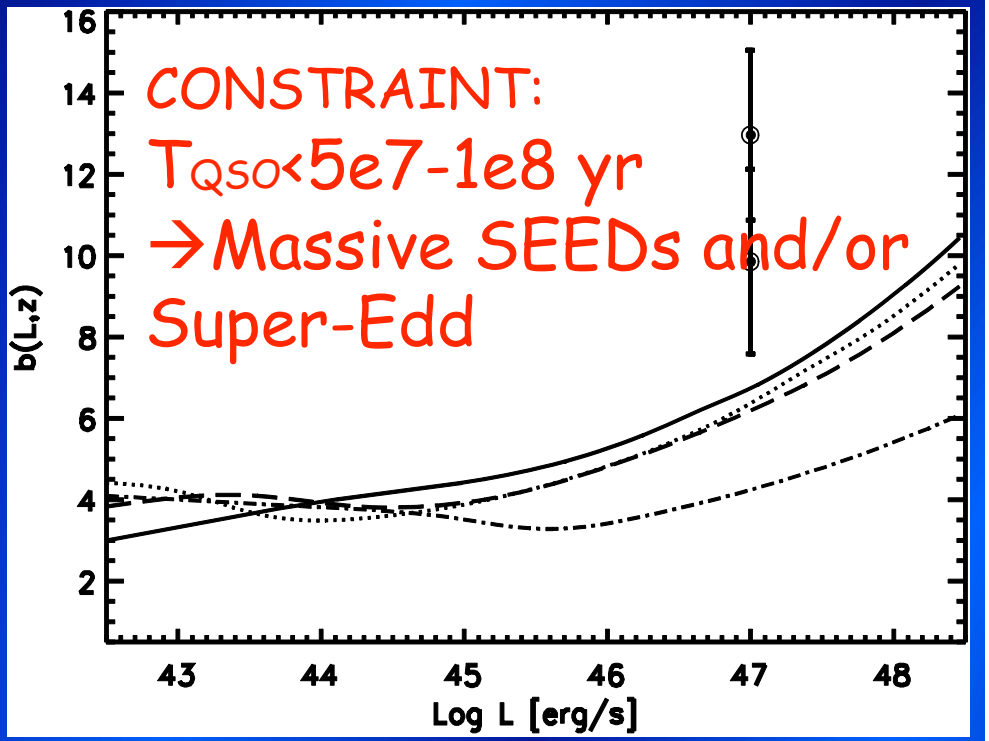


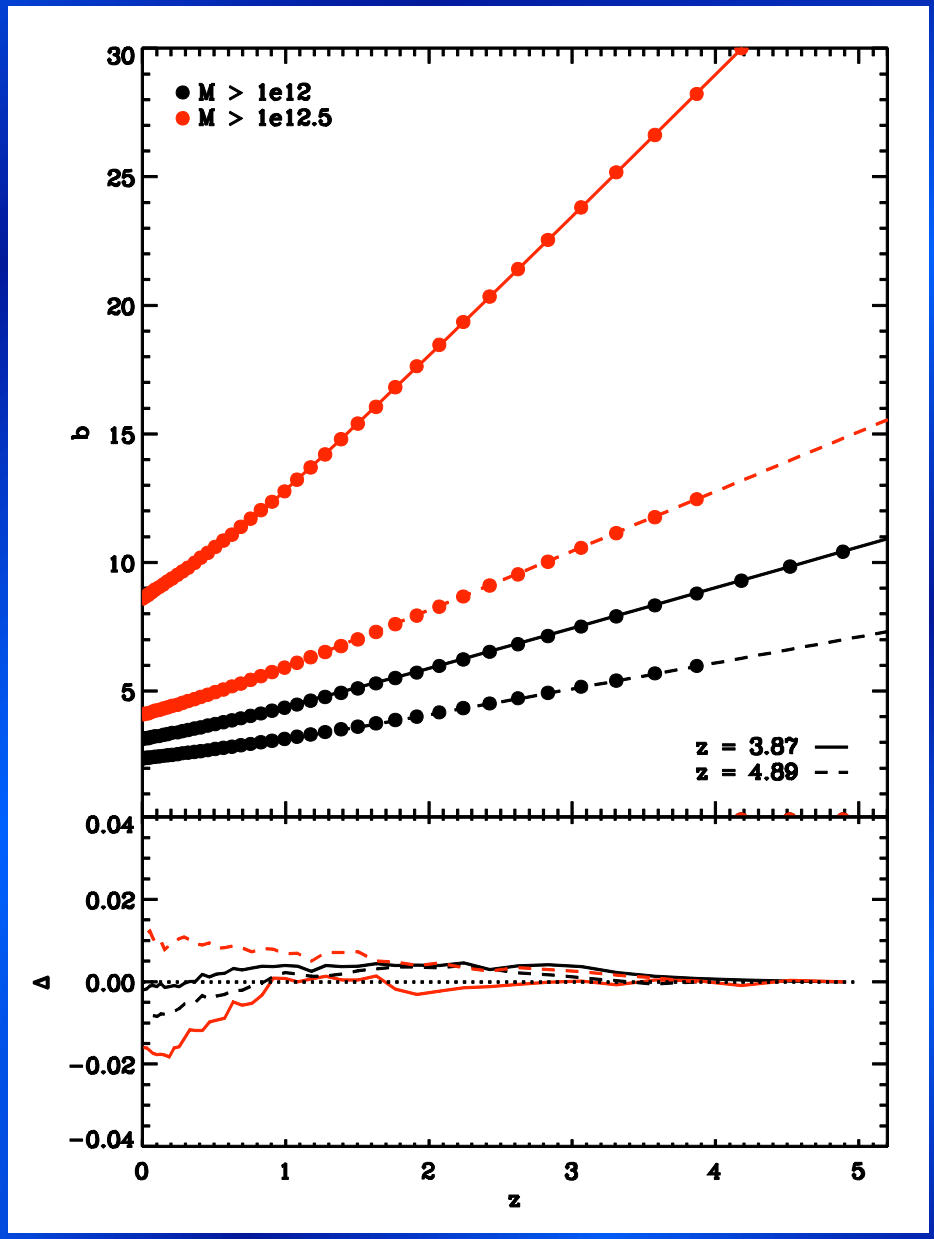


see Schawinski's talk!

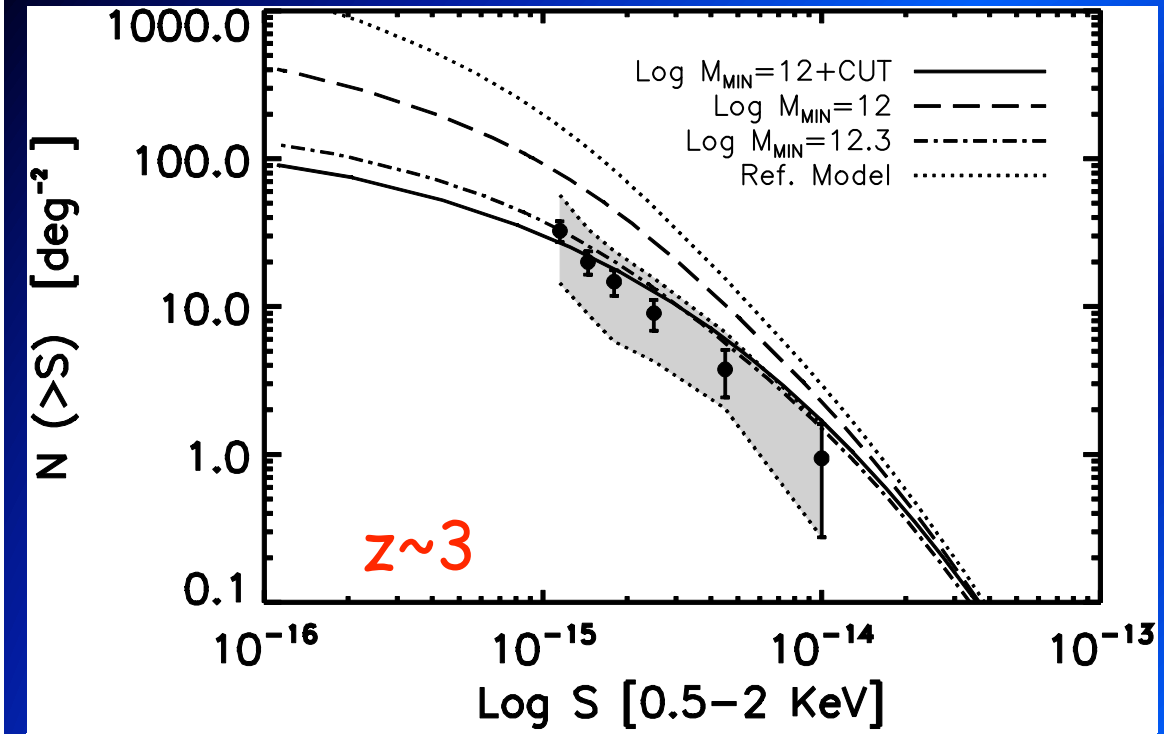
PASSIVE BIAS: A SIGNATURE OF RAPID BH GROWTH AND MASSIVE "SEEDs"

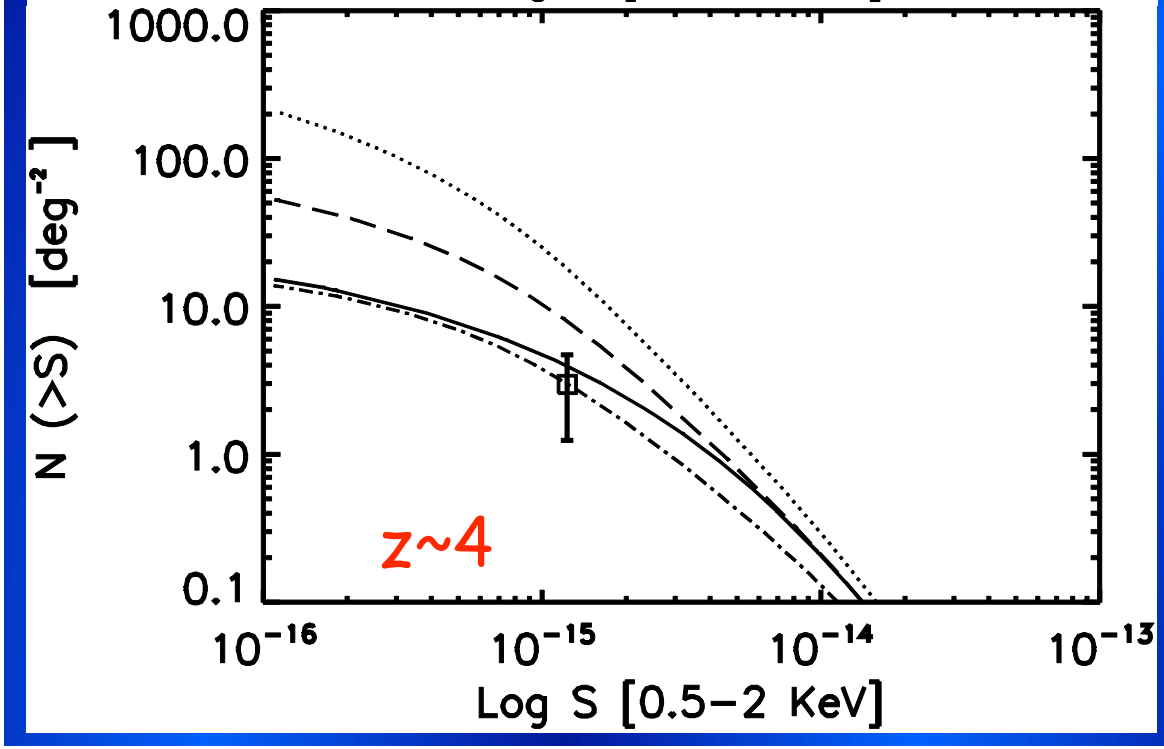
A long delay "lowers" the bias at the shining



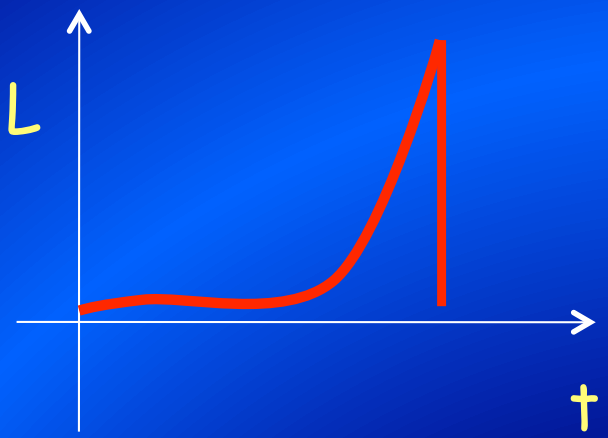


R. Angulo, M. Crocce





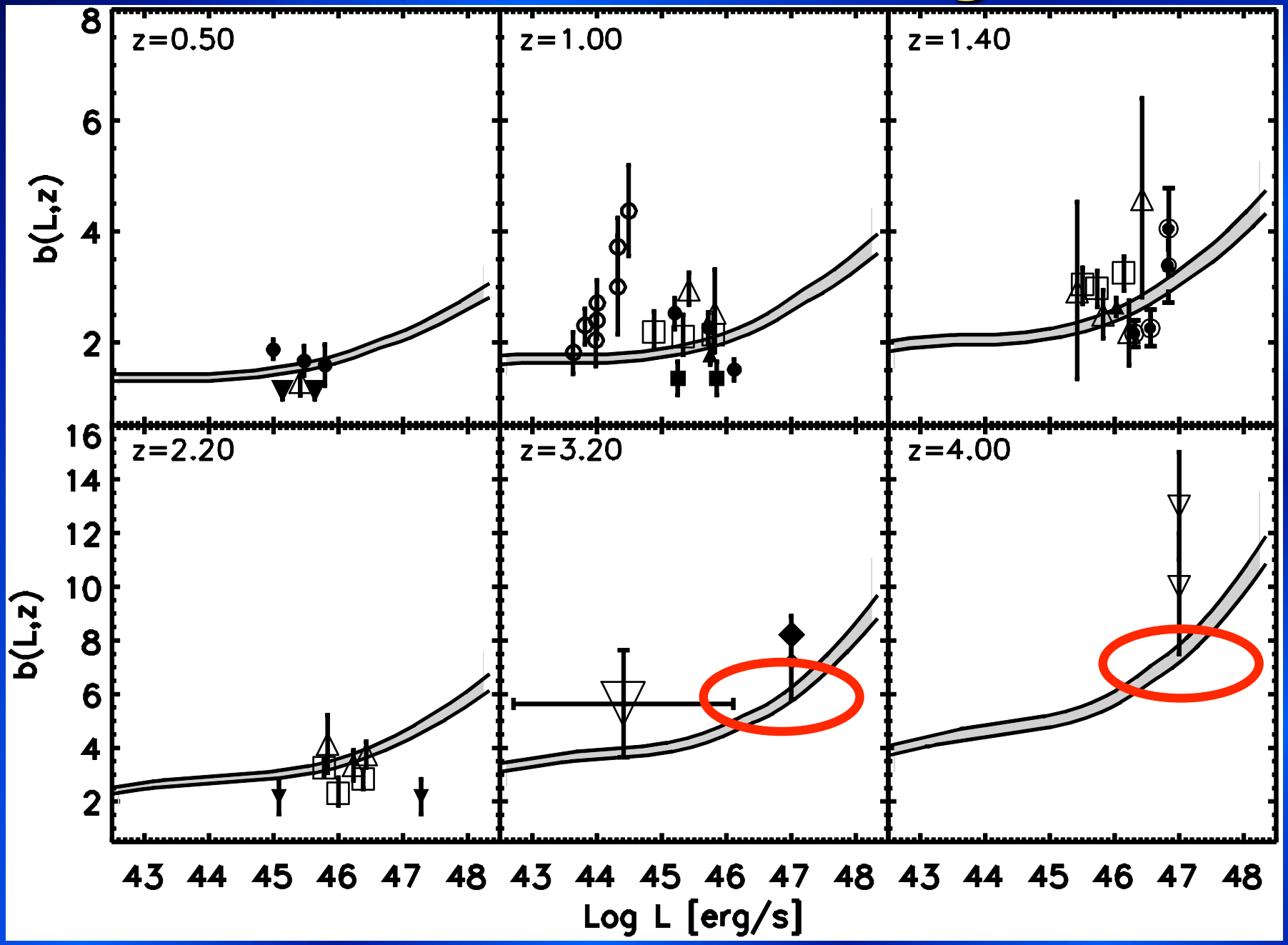
Additional constraints from deep X-ray counts: preferred *sharply declining* light curves.



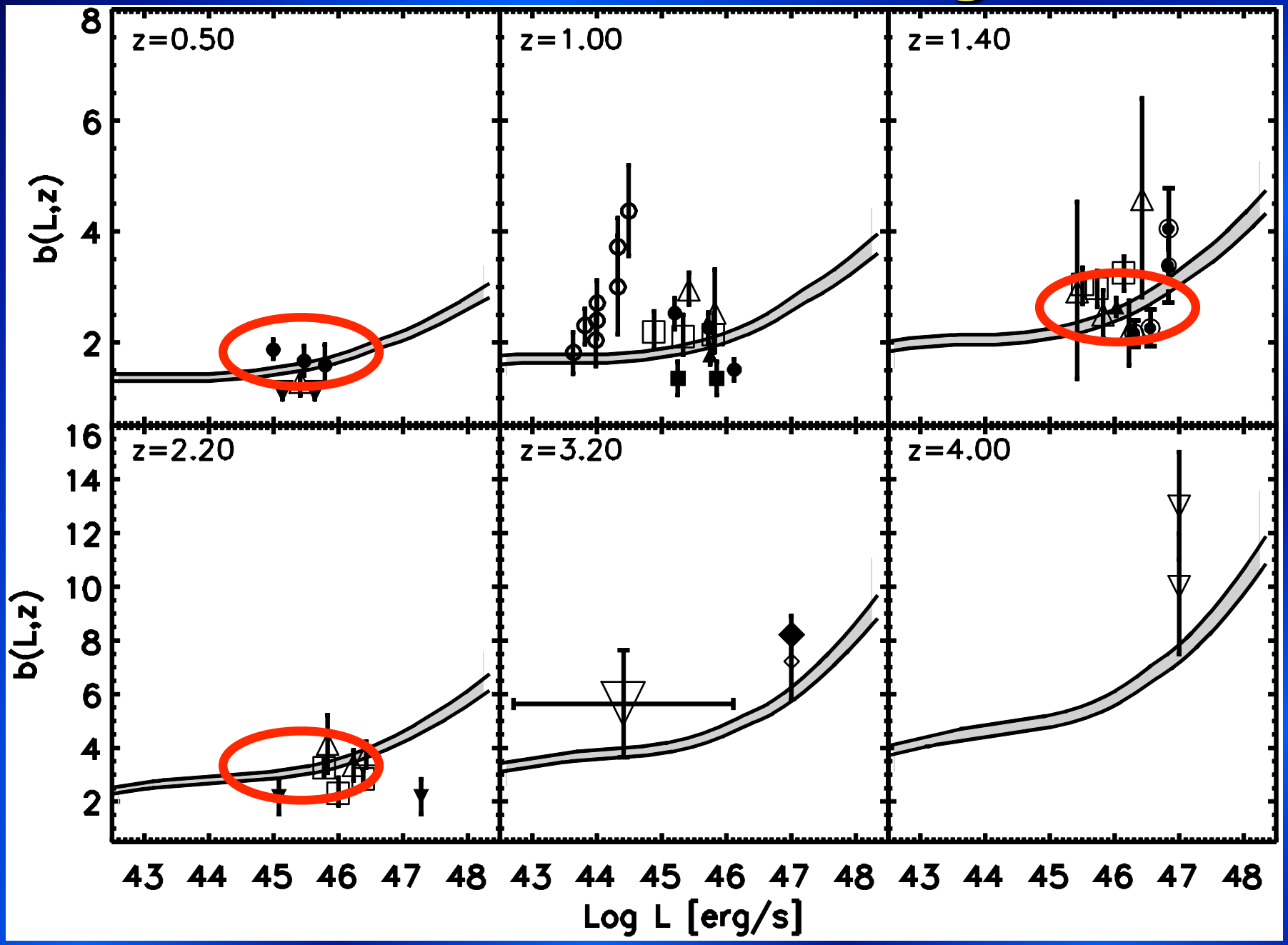
Marcella Brusa et al. 2009

Get additional information on high-z, obscured AGNs from the posters by E. Treister, A. Comastri, and F. Bauer

Quasar clustering

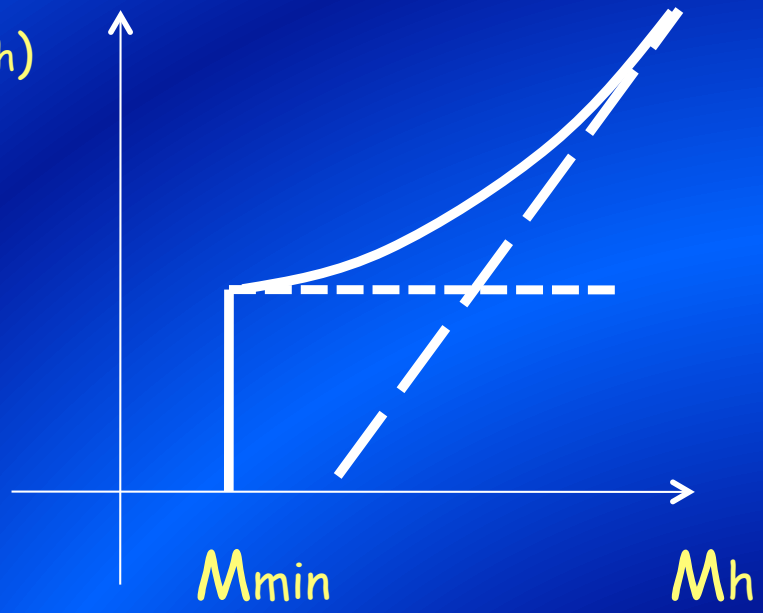


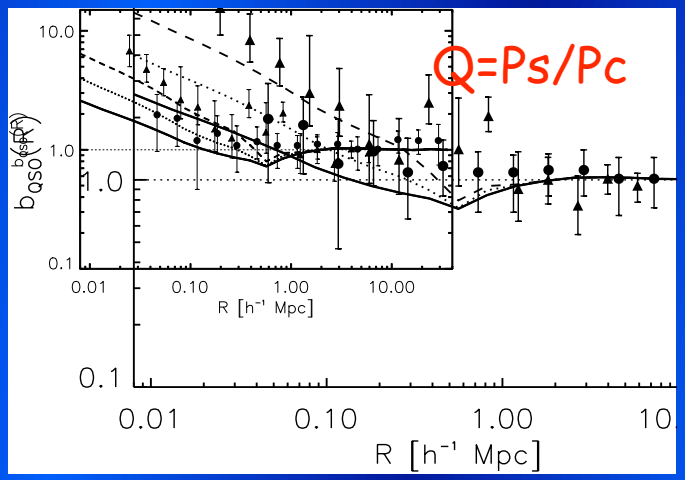
Quasar clustering



Seeding Centrals and Satellites with BHs

From match to large scales
minimum halo mass Mmin

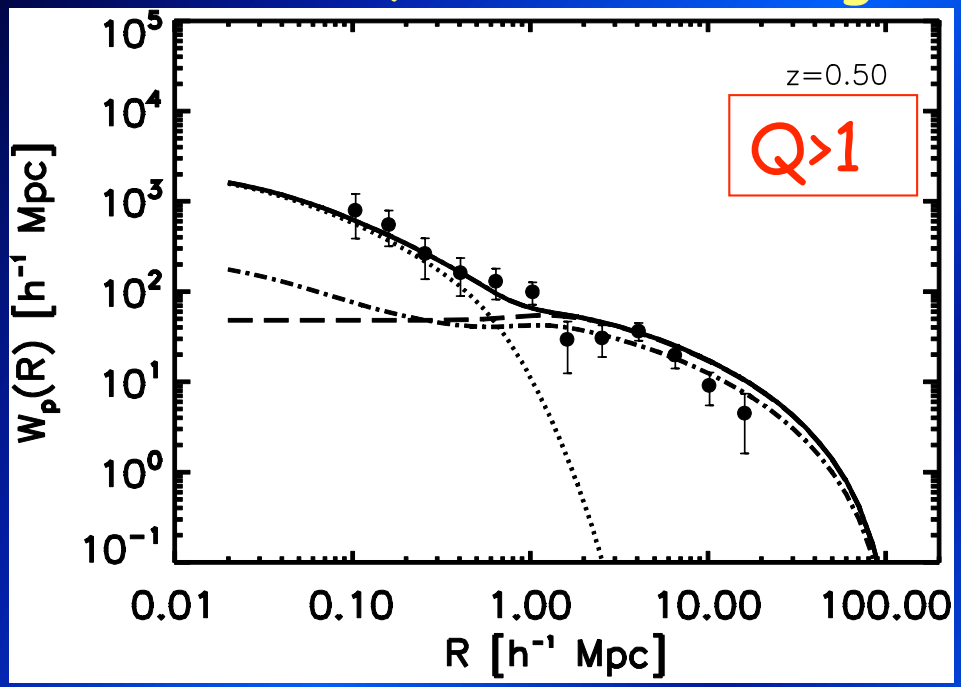


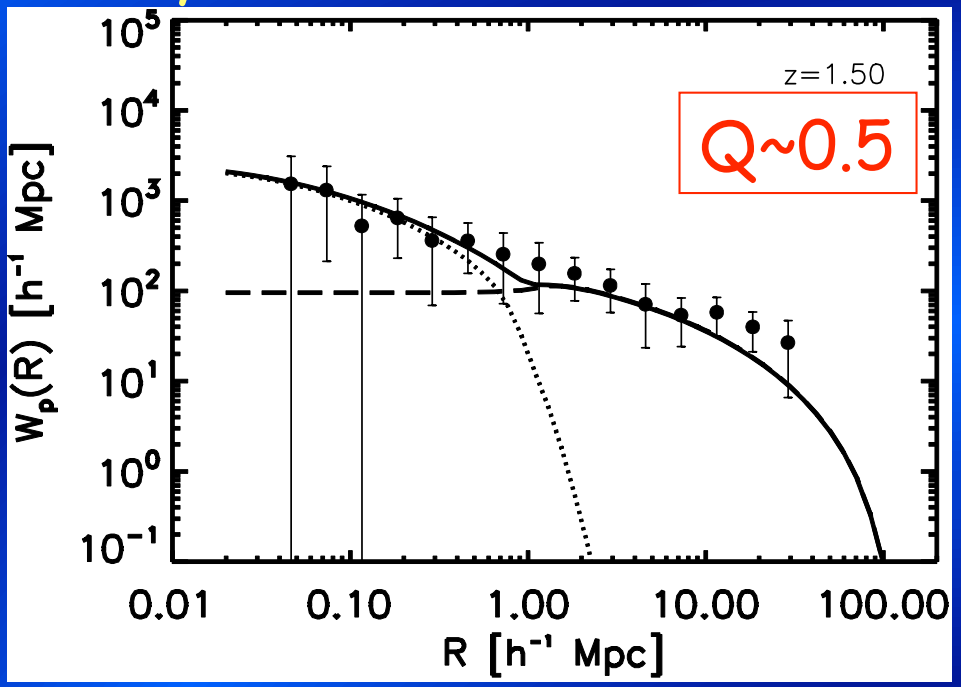


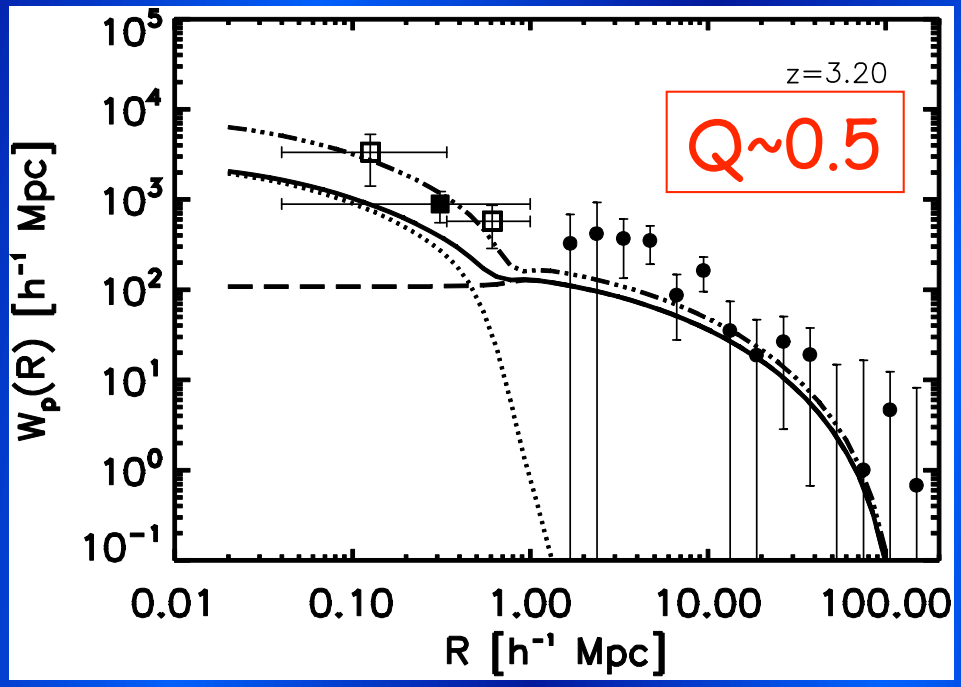
FS, D. Weinberg, J. Miralda-Escude' 2010

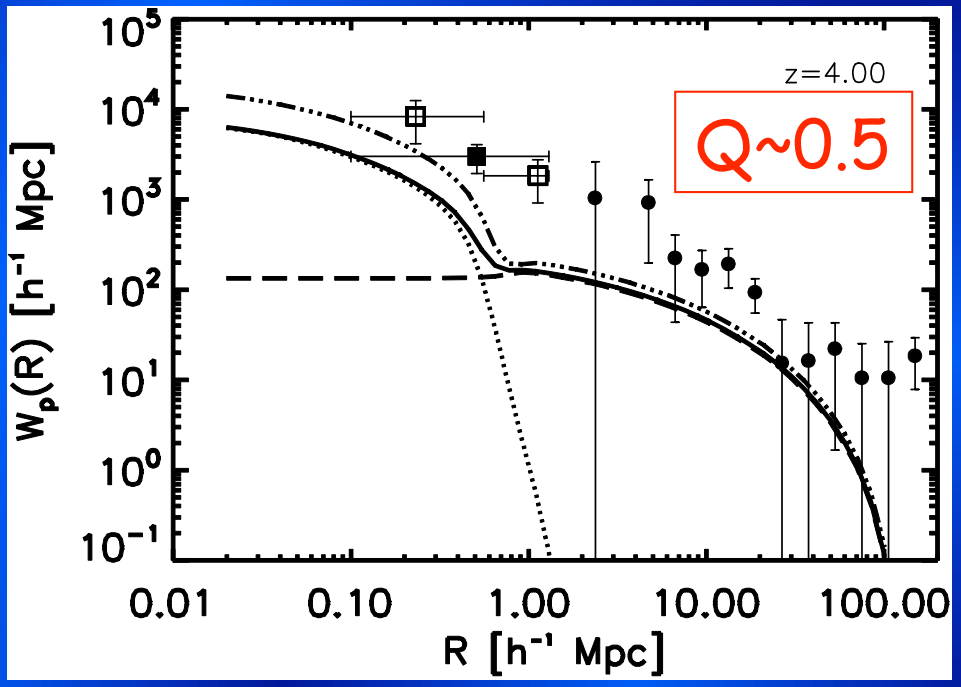
$$Pc(Mbh) + Ps(Mbh) \sim U(Mbh,z)$$
$$U(Mbh,z) \sim \Phi(L,z)/n(Mbh,z)$$

Q=Ps/Pc must significantly increase at z<1!



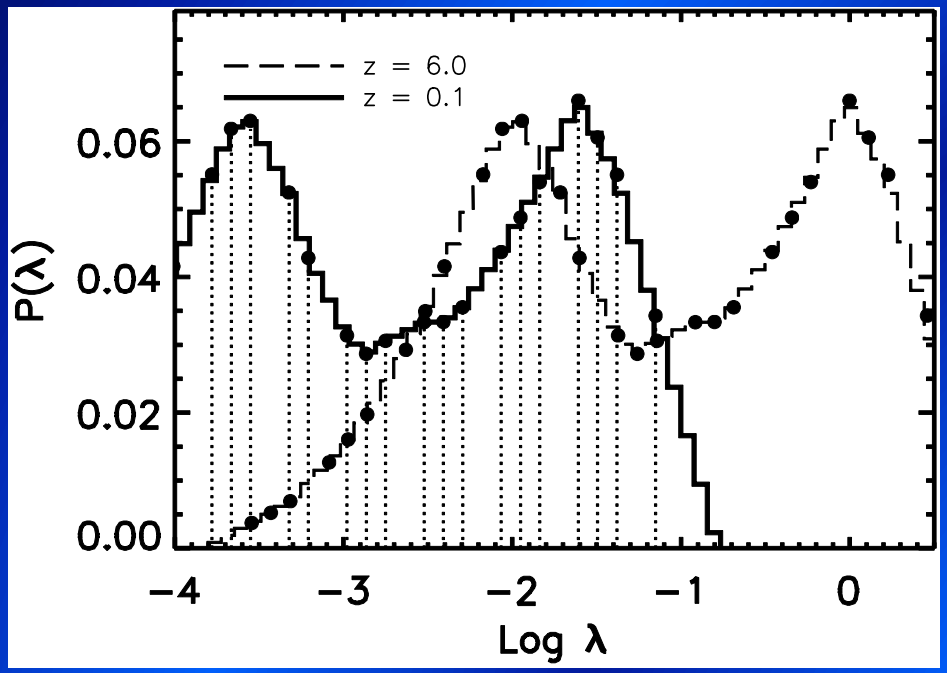






What are the predictions on Accretion properties?

P(L/Ledd) at fixed BH mass



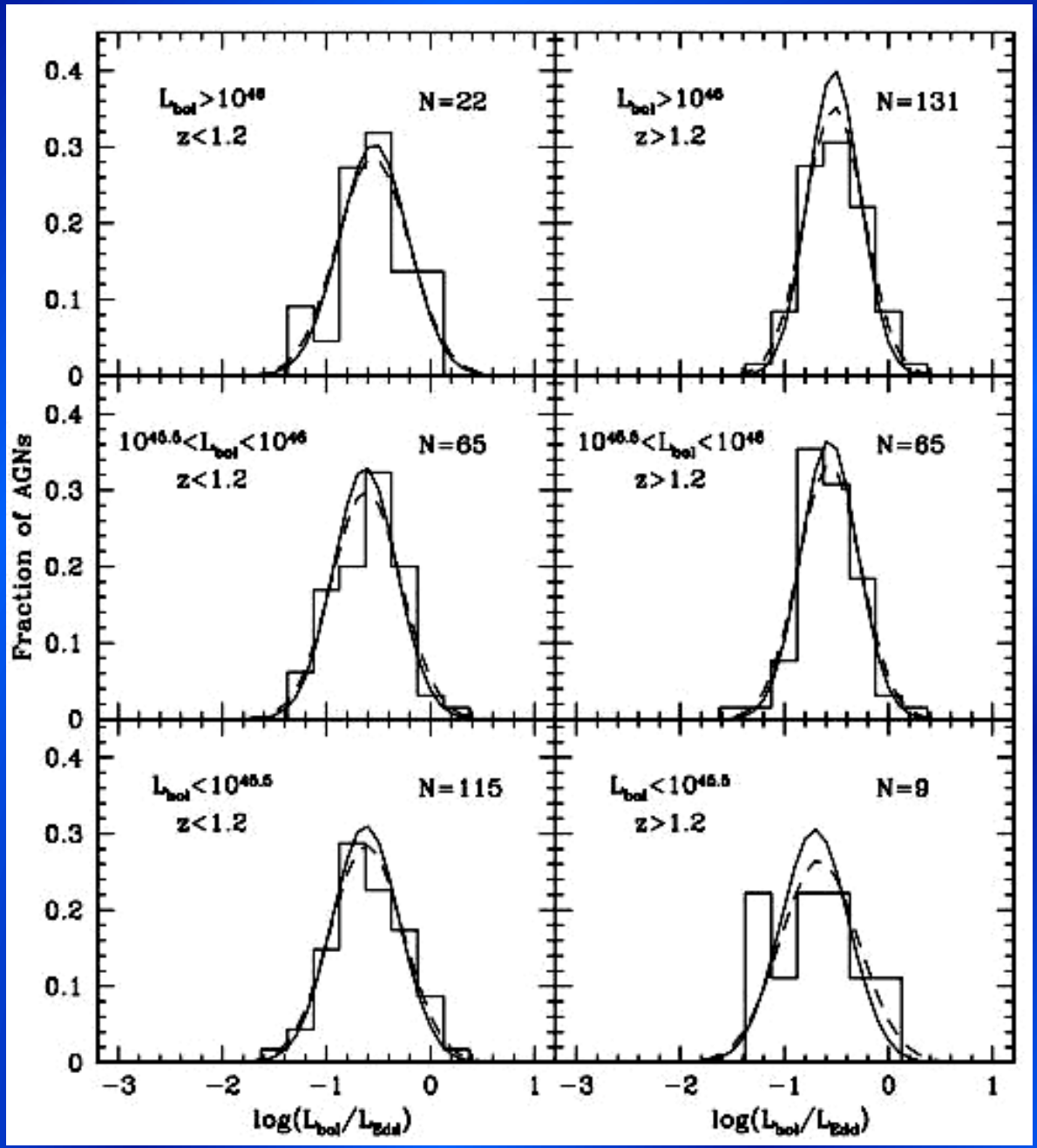
Time varying Lpeak-Mhalo relation + broadening LC

↓

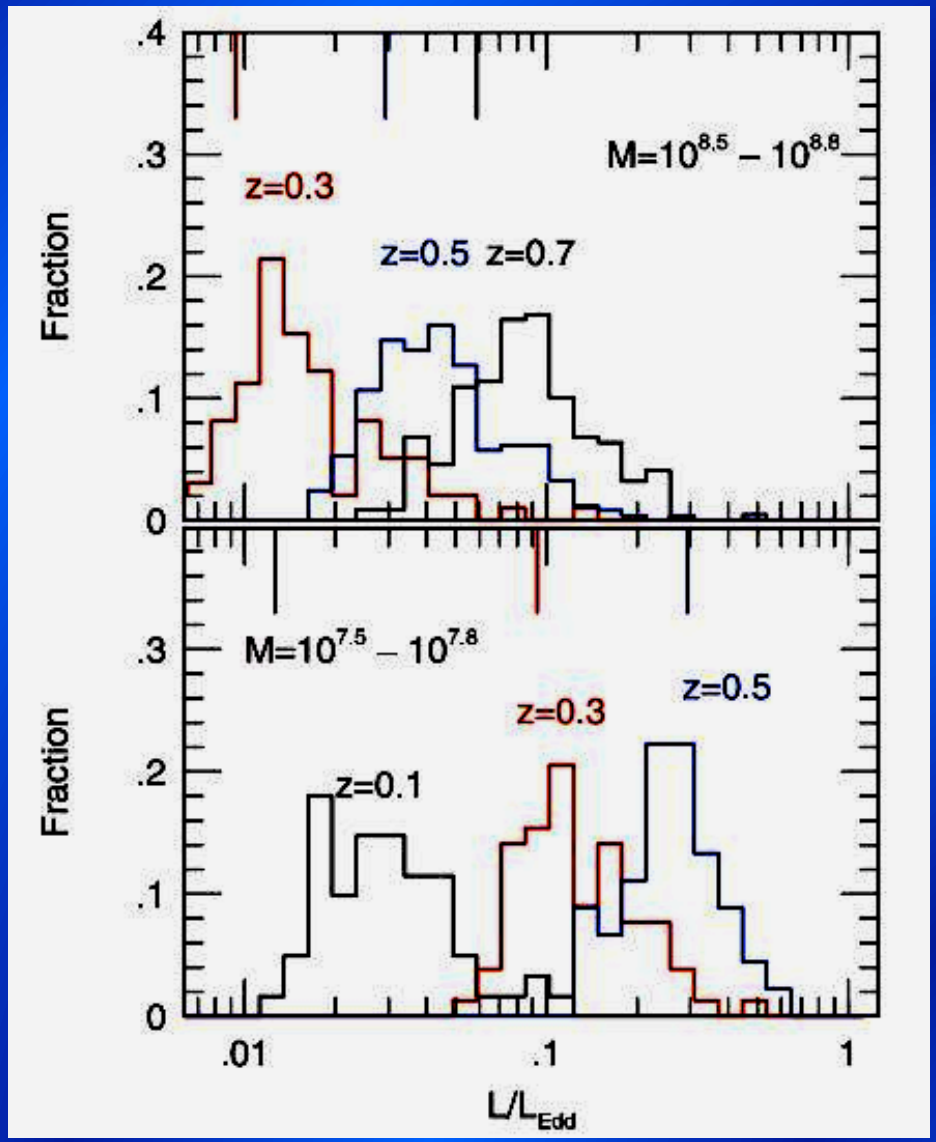
Decreasing Eddington Ratio distributions

↓

Large fraction of the XRBG formed by massive BHs accreting at low L/LEdd

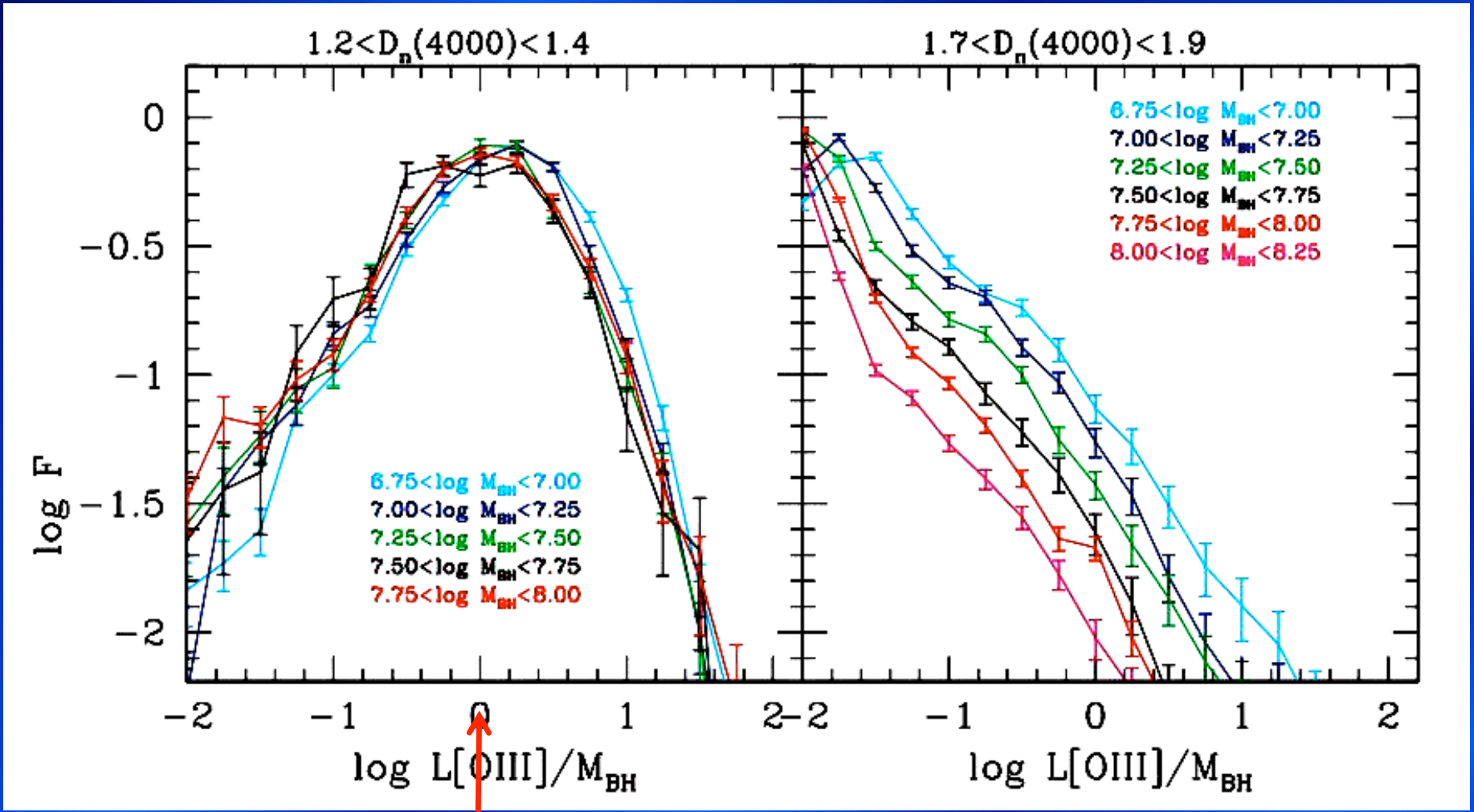


Kollmeier et al. 2006



Netzer & Trakhtenbrot 2007
(see also Vestergaard 2004 and Trakhtenbrot's poster!)

All SMBHs accreting at the same (low!) mode at z=0



Lbol/LEdd~1e-2

Kauffmann & Heckman 2009

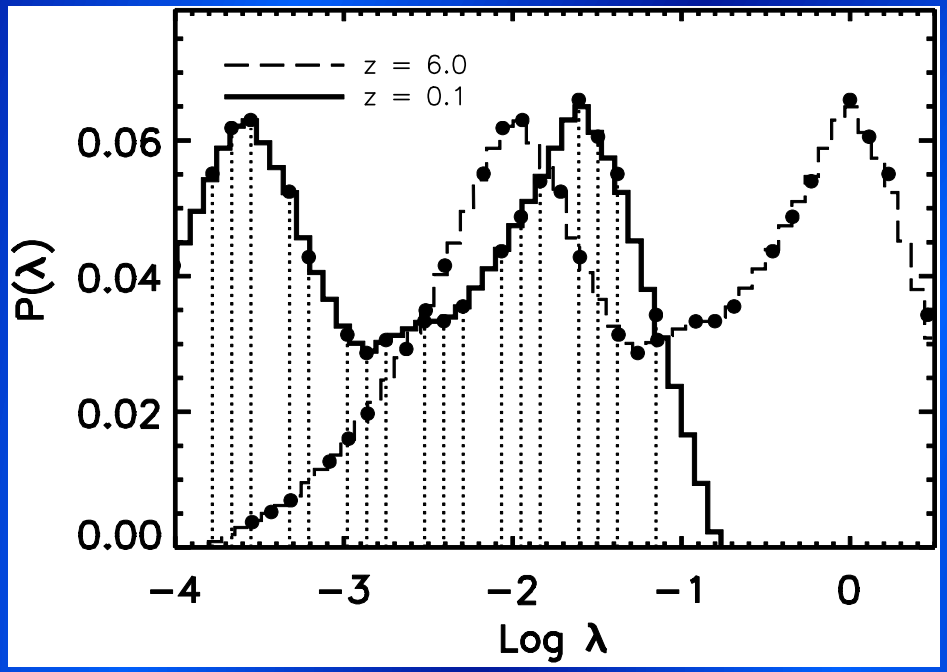
see Gandhi's + Brandt's talks!

Continuity Equation : for a more empirical approach!

$$\frac{\partial n(M_{BH},t)}{\partial t} = -\frac{\partial}{\partial M_{BH}}\left[\left\langle \dot{M}(M_{BH},t)\right\rangle n(M_{BH},t)\right] + \dot{S}_{in}(M_{BH},t) - \dot{S}_{out}(M_{BH},t)$$

$$\left\langle \dot{M}(M_{BH},t)\right\rangle = \sum_j p(\lambda_j, M_{BH}, z)\, U(M_{BH}, z)\, \frac{M_{BH}}{t_s};\quad t_s \approx \varepsilon t_E$$

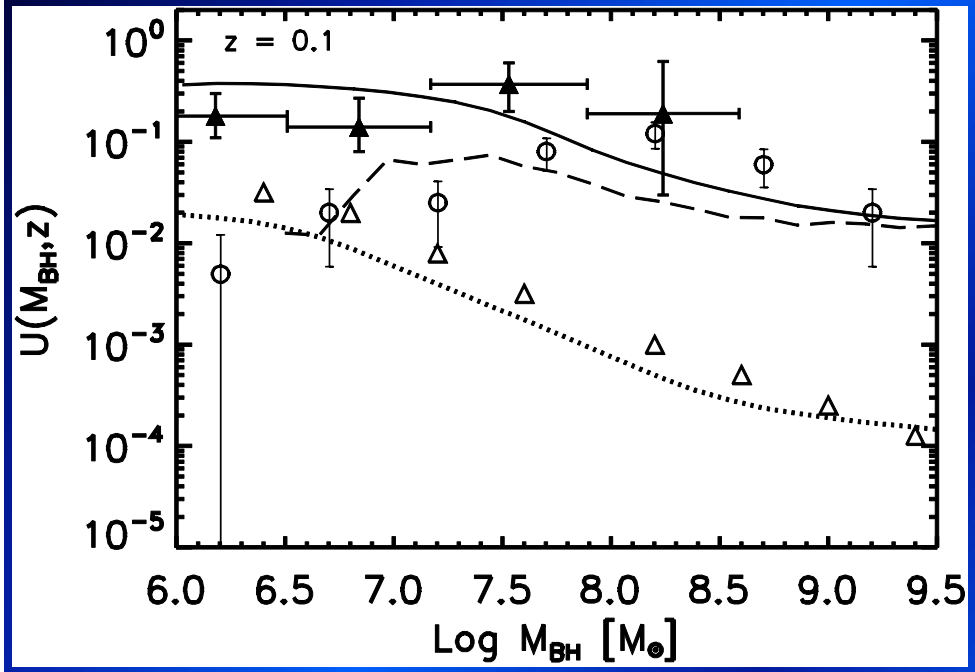
$$\Phi(L,z) = \sum_{M_{BH}} \sum_j p(\lambda_j, M_{BH}, z)\, U(M_{BH}, z)\, \Phi(M_{BH}, z) \Big| L \propto \lambda_j M_{BH}$$

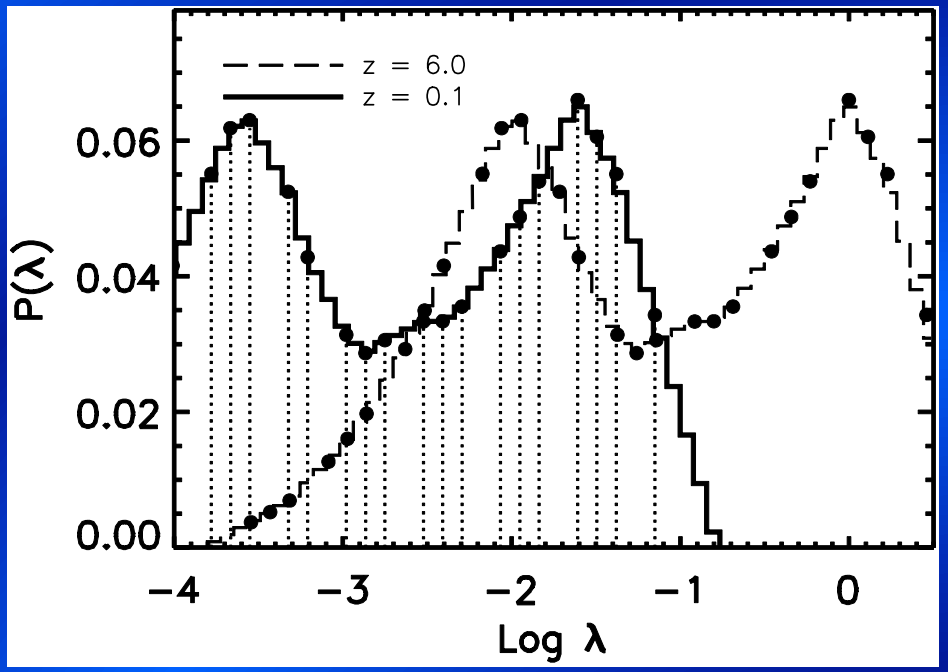


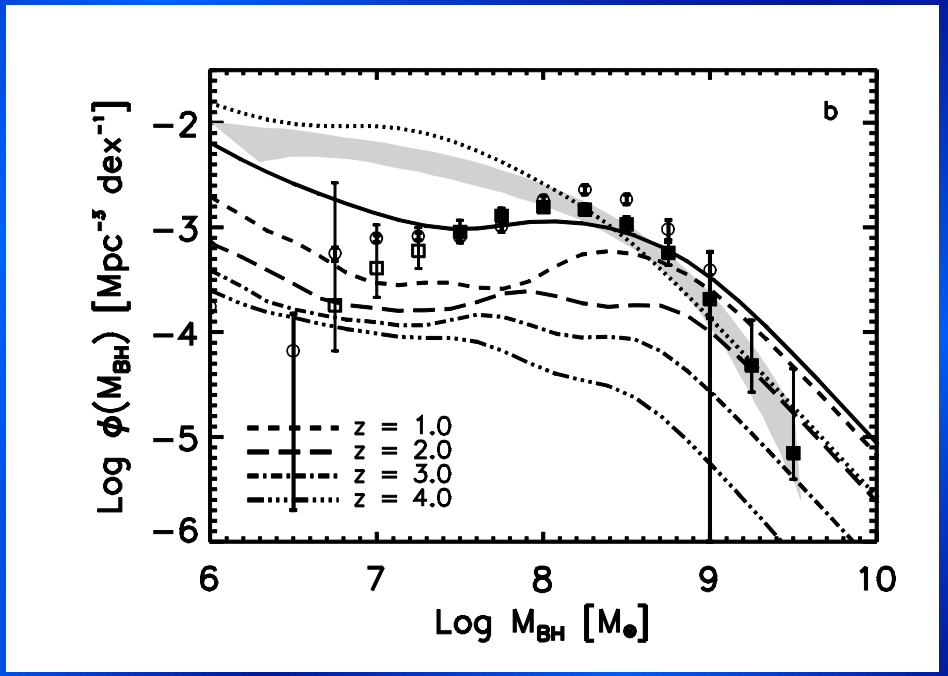
see Merloni's talk

FS, D. Weinberg, J. Miralda-Escude' 2010 FS 2009

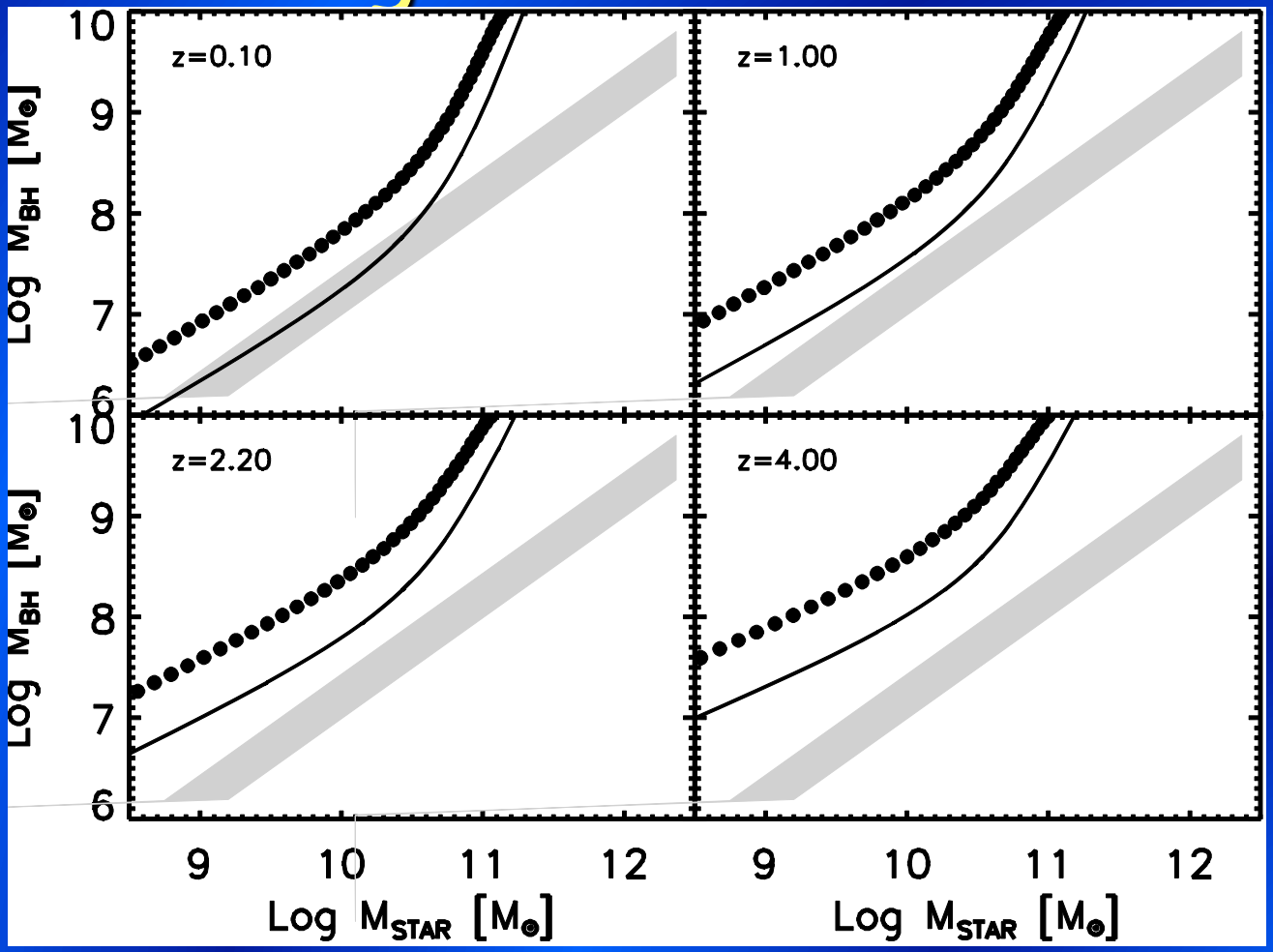
Consequences of a redshift-dependent P(L/Ledd)







Scaling Relations: an evolving Mbh-MSTAR relation?



$$M_{BH}(z) - M_H + M_{STAR}(z) - M_H$$

$$M_{STAR}(z) \propto \mathrm{Re}(z) \times \sigma^2(z)$$

See Decarli's talk!

CONCLUSIONS

Starting From a Basic Model for the Triggering and Shining of QSOs we find very general conclusions:

1-***High clustering of z>3 QSOs*** :
sharply peaked LC; super-Edd/massive BH seeds;

2-***Increasing*** fraction of active ***satellites*** with time

3-***Decreasing*** characteristic L/Ledd with time

4-***Flatter*** BH mass function at the low-mass end and ***higher*** number density of ***high-mass*** BHs

5-Scaling Relations :
at high-z favors higher Mbh/Mstar!